

ISSN : 2384-0307

제 40권 2호

2015

추계학술대회

PROCEEDINGS 연구논문

초록집

2015. 10. 6 [Tue] - 8 [Thu]

대구컨벤션센터(EXCO)

The Polymer Society of Korea Fall Meeting



한국고분자학회

The Polymer Society of Korea



대구컨벤션관광뷰로

염료감응형 태양전지(DSSCs)는 높은 태양에너지 광전변환 효율과 함께 제조 공정이 간단하며 단가가 저렴하여 많은 관심을 모으고 있다. 광전변환 효율을 높이기 위해 나노 구조의 TiO_2 및 신규 감광제 개발에 박차를 가하고 있으며, 최근 많은 효율 향상에 대한 보고가 이루어지고 있다. 본 연구에서는, 유기 형광물질을 광전극에 소광 첨가하여 광전변환 효율을 높이고자 하였다. TiO_2 표면에 직접 유기 형광 염료를 흡착시킴으로써 형광체가 방출하는 형광을 염료가 여기광으로 사용 할 수 있으며 이를 통하여 보다 효율적인 광전변환 효율을 기대할 수 있다. Forst Type Resonance Energy Transfer (FRET) System을 적용한 염료감응형 태양전지에서 높은 광전변환 효율을 달성하기 위하여, 유기 형광체의 형광파장과 염료의 흡수파장 사이에 중첩이 커야 한다. 본 연구에서는 다양한 유기형광체 (Energy Donor)와 염료 (Energy Acceptor)를 적용하여 높은 효율의 FRET System을 개발하고 이를 염료감응형 태양전지 소자에 적용하였다.

3PS-214 정노을

코발트계 및 아이오딘계 전해질을 이용한 염료감응 태양전지의 최적화

정노을, 이지원, 김동우, Suresh Toghiti, 김재홍[†] 영남대학교

염료 감응형 태양전지는 저비용, 고효율 특성의 태양전지로서 최근 학술적 및 상업적인 관심의 대상이 되고 있다. 값비싼 루테튬계 염료를 대체할 수 있는 다양한 유기염료가 개발되어 있으며 이를 포함한 염료 감응형 태양전지의 광전변환 효율도 급격히 증가하고 있는 실정이다. 특히 염료감응형 태양전지의 상용화를 위하여 아이오딘계 전해질이 가지는 부식성 등이 문제로 부각되고 있어 다양한 전해질 소재 개발이 진행되고 있다. 본 연구에서는 최근 많은 관심을 모으고 있는 cobalt계 전해질을 적용하여 염료 감응형 태양전지의 소자 구조를 최적화 하였으며, 이를 통하여 cobalt계 전해질이 광전변환 효율에 미치는 소자 구조적 인자를 검토하였다.

3PS-215 정승영

Alkynyl-Substituted D- π -A Structural Zn(II)-Porphyrin Sensitizers Containing Various Donor Units for Dye-Sensitized Solar Cells

정승영, 김환규[†], 강성호 Global GET-Future Lab, and Department of Advanced Materials Chemistry, Korea University

Dye-sensitized solar cells (DSSCs) have been regarded as next-generation photovoltaics for providing electricity at lower expense and more versatility. Porphyrins are one of the most widely studied sensitizers for DSSCs because of their absorbing strong Soret bands and Q bands. New alkynyl-substituted porphyrin sensitizers were designed and synthesized with the combination of the bulky triphenylamine (TPA) derivatives as the donor, such as dihexyloxy-substituted TPA and bis(dihexyloxy)phenyl-substituted TPA moiety, double alkynyl-substituted porphyrin as the π -bridge and benzothiadiazole (BTD)-based derivative as the acceptor. Porphyrin with doubly alkynyl substituent was introduced as the π -bridge unit for red-shifting the Soret and Q bands with respect to single alkynyl-substituted porphyrin. In this study, their structure-performance relationships were investigated with the influence of the various donor moieties on the photophysical, electrochemical and photovoltaic properties.

3PS-216 정아라

The Linear and Branched Alkyl Side Chains on Planar Semiconducting Molecules: Nanoscale Morphology Mediators between π -Conjugated Backbones and PC_{71}BM s

정아라, 옥주원, 김봉수[†] 이화여자대학교

We synthesized three new planar aromatic backbone molecules (Eh-Hex, Eh-Eh, and Oct-Eh), where the appended alkyl side chains on the aromatic core unit are either 2-ethyl hexyl (Eh) or n-octyl (Oct) and those on the side ends are either Eh or hexyl (Hex). Molecular film characterizations revealed that all the molecules were crystalline and assumed mainly edge-on orientation, while the molecules (Eh-Hex, Eh-Eh) manifested higher crystallinity than the molecule (Oct-Eh). In molecule: PC_{71}BM blend films only the Eh-Hex molecule exhibited a good intermolecular packing and formed uniformly distributed nanoscopic networks of molecular channels, maintaining high interfacial contacts between the Eh-Hex and PC_{71}BM domains. In contrast, the Eh-Eh molecules showed poor miscibility with PC_{71}BM and the Oct-Eh molecules displayed too much miscibility with PC_{71}BM molecules. These differences resulted in the significant differences in the photovoltaic performance of the molecule: PC_{71}BM blend devices.

3PS-217 정용진

Preparation of Photo-Patterned ZnO Film for Low-Voltage Oxide Thin Film Transistors using Polymeric Zinc Acrylate

정용진, 박선욱, 김래호, 김예별, 백용화, 장진혁, 정재영[†], 김세현[‡], 박찬연[†] 포항공과대학교; [‡]한양대학교; [‡]영남대학교

Metal oxide thin film transistors (TFTs) have attracted considerable attention as an alternatives to silicon-based devices for use as the various electronic applications such as display backplane, and integrated sensor because of the advantage of favorable electrical performance, and uniformity. Solution-processes are more promising techniques to prepare oxide semiconductor films compared to vacuum deposition methods because of low manufacturing costs. However, the solution-processed oxide semiconductor films need additional patterning processes including photolithography or direct-printing methods. In this study, we prepared a photo-patterned zinc oxide thin films by using a photosensitive organic compound as the zinc precursor of oxide semiconductors. It might be possible to develop a very simple and eco-friendly film patterning process. We prepared the ZnO TFT with the low-voltage operation within ± 3 V, by utilizing $\text{Al}_2\text{O}_3/\text{TiO}_2$ laminate film as a dielectric layer.

3PS-218 정의혁

Isosindigo-Based Conjugated Polymer with Medium Bandgap for Polymer Solar Cells with High Open Circuit Voltage Exceeding 1 V

정의혁, 조재웅, 정재웅, 조원호[†] 서울대학교

Medium bandgap polymers have attracted interest for achieving high performance PSCs due to low-lying HOMO energy level and different light absorption region complementary

with the absorption region of low bandgap polymer. Hence, the medium bandgap polymer affords high VOC to PSCs and can also be used as a short-wavelength absorber in multi-junction PSCs with low bandgap polymer. We synthesized isosindigo-based medium bandgap conjugated polymer (PI2FT) consisting of isosindigo and difluoro-bithiophene. PI2FT showed the optical bandgap of 1.63 eV and the HOMO energy level of -5.71 eV, respectively. The PSCs fabricated from PI2FT:PCBM blend shows a PCE of 7.9% with a VOC of 1.03 V in conventional device architecture. To the best of our knowledge, the VOC of 1.03 V is among one of the highest ones for PSCs. Therefore, this result clearly demonstrates that PI2FT is a promising material as short-wavelength absorber for series-connected multi-junction PSCs to obtain high VOC approaching 2 V.

3PS-219 정인아

Organic solar cells using 6-(2-thienyl)-4H-thieno[3,2-b]indole (TTI) copolymer with PCE of 2.6%

정인아, 김동준, 김진우, 서홍석[†] 부산대학교

Bulk-heterojunction organic solar cells (BHJ OSCs) based on conjugated polymers have been received most attention because potential of being fabricated of flexible and light-weight substrates. Although polymers have been widely used to BHJ OSCs and achieved power conversion efficiencies (PCEs) over 10%. We synthesized alternating conjugated polymers, PTTTBT and PTTTMBI, 6-(2-thienyl)-4H-thieno[3,2-b]indole (TTI) which was modified from benzene ring to thiophene ring in carbazole moiety used for electron-rich unit and BT/MBI used for electron-deficient units. All of polymers have good solubility in common organic solvents. PTTTMBI has the lower band gap of 1.57 eV. Optical and electrochemical characterizations exhibit that polymers have proper energy diagram. The power conversion efficiencies of PTTTMBI show 2.60 %.

3PS-220 정주형

Energy Transfer Characteristics of Rubrene Nanorods and CdSe/ZnS Quantum Dots of the Optical Waveguides Based on a Composite Materials

정주형, 등학성, 전수민, 문우성[†], 조은희[‡], 이주복[‡], 주진수[‡], 이광섭[‡] 한남대학교; [‡]고려대학교

Nano-optical waveguides are very important in the context of nanophotonic devices. In this research we investigate the optical properties of rubrene nanorod-CdSe/ZnS quantum dot (QD) hybrids. Nanorods (NR) constituting the organic dye rubrene was synthesized using physical vapor transport method. Blue and green color emitted CdSe/ZnS quantum dots was synthesized using thermal decomposition method. Blue as well as Green QDs were partially attached to the surface of NRs through suitable ligands. The Nanoscale waveguiding property of the NRs and QD-NR hybrids were investigated using laser confocal microscopy photo luminescence (LCM PL) spectroscopy. The results could be understood in terms of Förster resonance energy transfer confirm in rubrene NR/blue-QDs system.

3PS-221 정지혜

Effect of Molecular weight of n-type NDI based polymer on photovoltaic properties

정지혜, 이창연, 이원호, 김범준[†] KAIST

Molecular weight of conjugated polymers significantly change crystallinity, solubility of organic solvents and miscibility with other polymers, which is essential aspects for determining performance and stability of all-polymer solar cells. Here in, a series of n-type naphthalene diimide (NDI) bithiophene copolymers (P(NDI2HD-T2), HD=2-hexyldecyl) with different molecular weights ($M_n = 14, 23, 50$ kg/mol) were synthesized. Their electrical, structural and photovoltaic properties were investigated. Particularly, pristine films of P(NDI2HD-T2) displayed clear tendencies of packing structures followed by grazing incidence X-ray scattering data. High M_n P(NDI2HD-T2) film preferred face-on oriented packing, while low M_n P(NDI2HD-T2) film favored edge-on directed packing. Finally, improved charge transport mobility of optimized device of high M_n P(NDI2HD-T2) with donor PTB7-Th lead to high power conversion efficiency 5.85% compared to 4.29% of low M_n P(NDI2HD-T2) without additive.

3PS-222 정희연

Synthesis and Characterization of Small Conjugated D- π -A Molecules Containing Benzotriazole Units for Photovoltaics

정희연, 김태동[†] 한남대학교

Benzotriazole (BTZ) units are known for relatively weak electron acceptors compared to benzothiadiazole, diketopyrrolopyrrole, and quinoxaline building blocks. However BTZ-based copolymers can still achieve over 7% of power conversion efficiency in organic photovoltaics even though they had medium band gap. These results can be speculated in employing a tandem cell structure with two active layers absorbing different parts of the solar spectrum. Here we present the synthesis and properties of the π -conjugated small molecule, oligomer and polymer containing a BTZ building block as an acceptor alternated with a carbazole donor. A small conjugated molecule, BTZCZ-2, was prepared for comparing the effects of molecular weights on the OPV performance fabricated by conventional and inverted solar cell devices. The best power conversion efficiency (over 5%) was achieved from BTZCZ-2/PC[71]BM with a PEIE/ZnO interlayer in the inverted solar cell architecture.

3PS-223 정희정

Flexible, Transparent and Eco-Friendly Starch Substrate for Low-Cost Disposable OFETs

정희정, 이화성[†] 한밭대학교

최근 플렉서블 디스플레이의 구현을 위해 기존의 무기물 기반의 기판을 대체할 투명한 기판에 대한 연구가 활발히 진행되고 있다. 현재 대표적으로 PET(polyethylene terephthalate), PEN(Polyethylene naphthalate), PC(polycarbonate), PES(Polyester)와 같은 고분자 기판을

Isoindigo-Based Conjugated Polymer with Medium Bandgap for Polymer Solar Cells with High Open Circuit Voltage Exceeding 1 V

정의혁, 조원호*

서울대학교 재료공학부

Introduction

Advantages of isoindigo and 3,3'-difluoro-2,2'-bithiophene for high-performance polymer solar cells



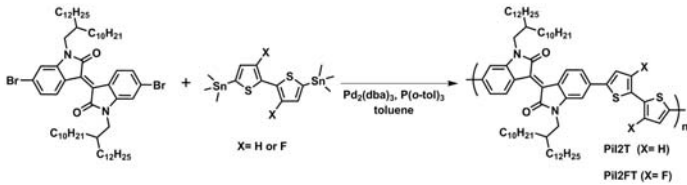
- Two lactam rings with strong electron withdrawing property
⇒ Deep HOMO energy levels
- Highly planar π -conjugated structure
⇒ High hole mobility of OFETs
- Highest electronegativity of F atom
⇒ Lowering energy levels
- Favorable molecular orientation for PSCs
⇒ High short-circuit current density

Objectives

- For high efficient polymer solar cells, synthesis of alternating conjugated copolymer with isoindigo and 3,3'-difluoro-2,2'-bithiophene and characterization of photovoltaic properties of the polymer
- For environmental device fabrication, process of polymer solar cells with non-halogenated solvents (e.g. *o*-xylene and diphenyl ether)

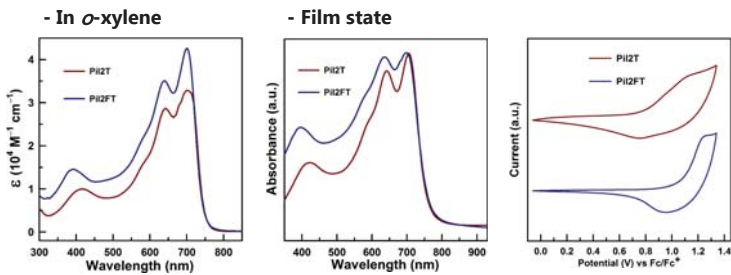
Results

Synthesis of PiI2T and PiI2FT

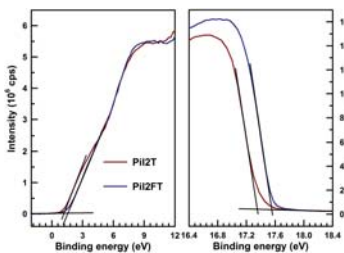


Optical and electrochemical properties of the polymers

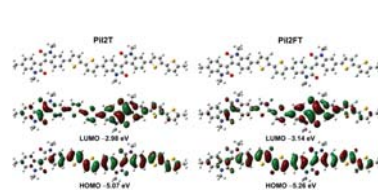
- UV-vis absorption spectra
- Cyclic voltammograms



UPS spectra



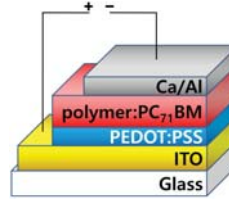
DFT calculations



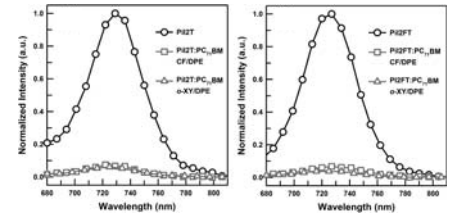
Polymer	Absorption		E_g^{opt} (eV)	HOMO _{CV} (eV)	IP _{UPS} (eV)	HOMO _{DFT} (eV)	LUMO (eV)	$\Delta\mu_{ge}$ (D)
	ϵ ($10^4 \text{ M}^{-1} \text{ cm}^{-1}$)	λ_{onset} (nm)						
PiI2T	4.26	752	1.65	-5.38	5.06	-5.07	-3.73	2.76
PiI2FT	3.29	752	1.65	-5.48	5.23	-5.26	-3.83	8.39

Photovoltaic performance of the polymers

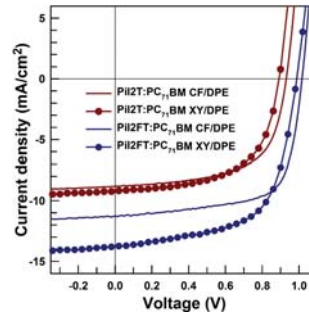
Device structure



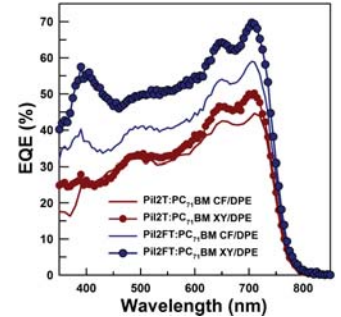
PL quenching spectra



J-V curves of PSCs



EQE spectra



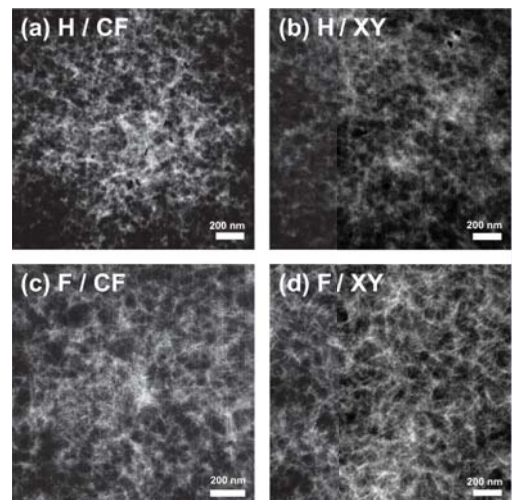
Polymer	solvent	V_{oc} (V)	J_{sc} (mA/cm ²)	FF	PCE (%)
PiI2T	CF/DPE ^{a)}	0.93	8.82	0.62	5.09
	XY/DPE ^{b)}	0.89	9.21	0.60	4.92
PiI2FT	CF/DPE	1.02	11.25	0.69	7.92
	XY/DPE	0.99	13.78	0.62	8.46

polymer:PC₇₁BM (1:1.5 w/w)

a) chloroform containing 3 vol% diphenyl ether; b) *o*-xylene containing 3 vol% diphenyl ether.

Morphology of active layers

TEM images



Conclusion

- The isoindigo-based low bandgap copolymer, PiI2FT, was successfully synthesized and showed the power conversion efficiency of 7.92% with V_{oc} of 1.02 V in CF:DPE (97:3 v/v). In addition, the PSCs processed with *o*-xylene:DPE (97:3 v/v) exhibited the PCE of 8.46% with V_{oc} of 0.99 V.